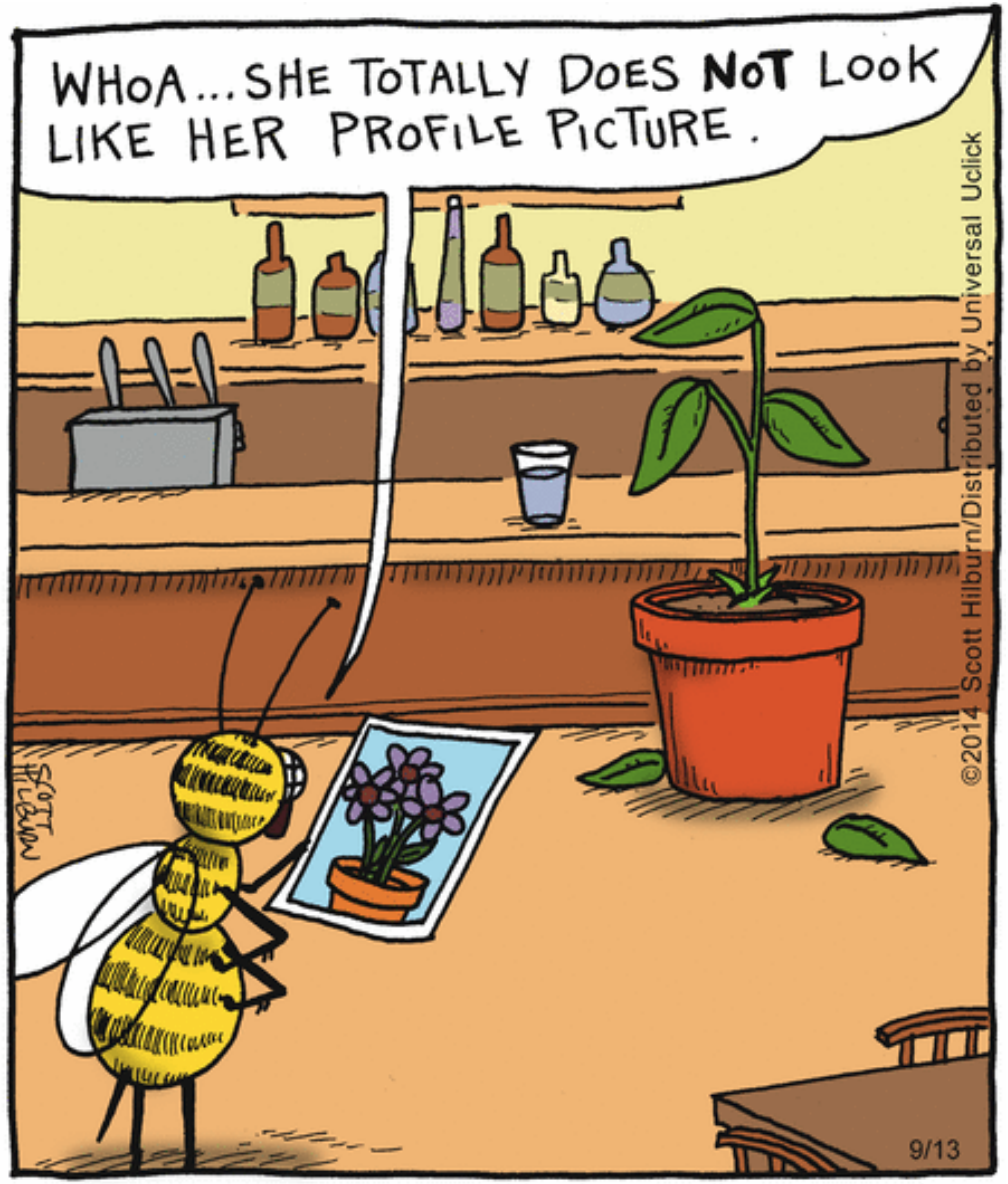
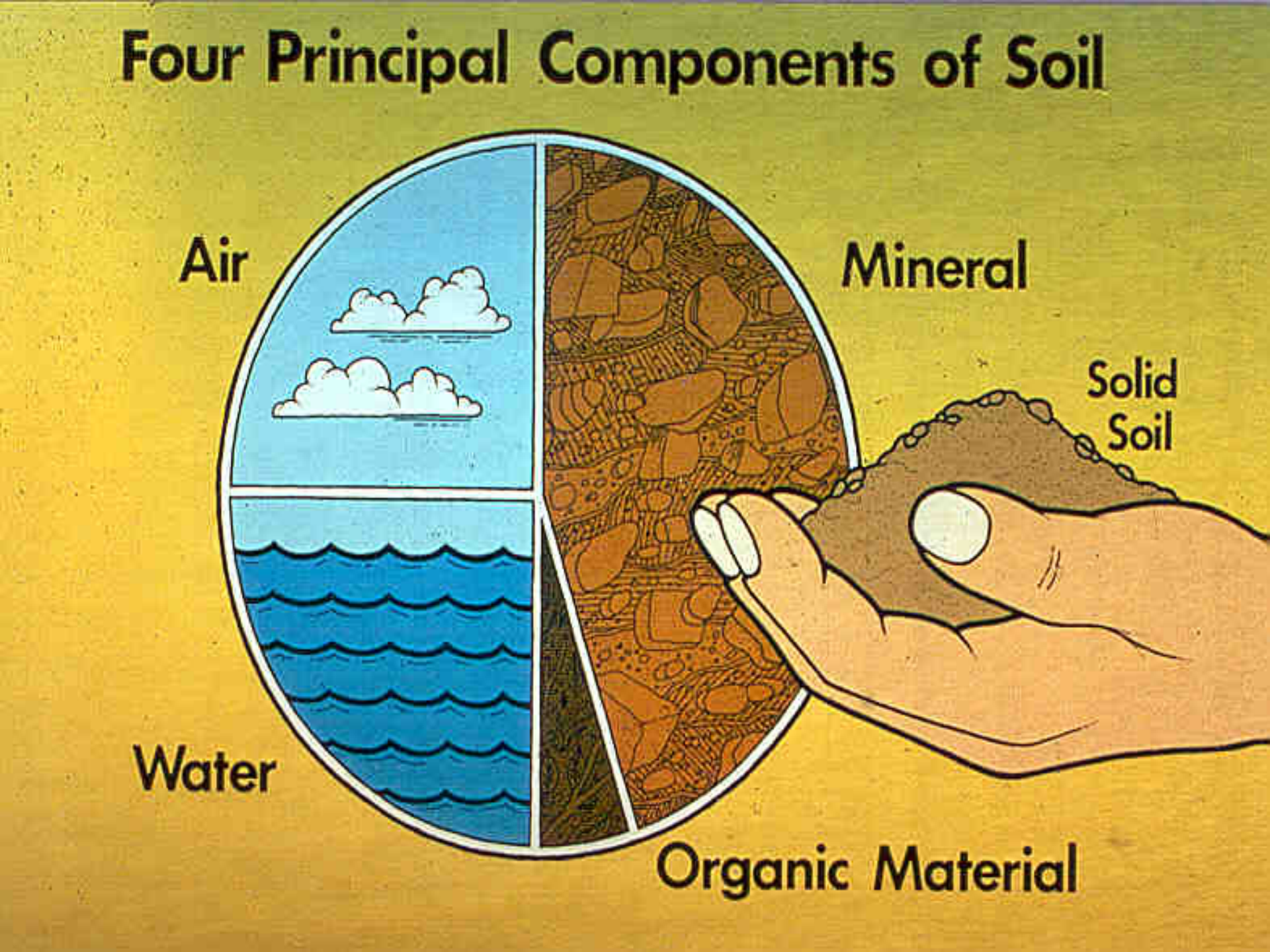
Olericulture – Hort 320
Lesson 6, Fertility, Irrigation, Pests

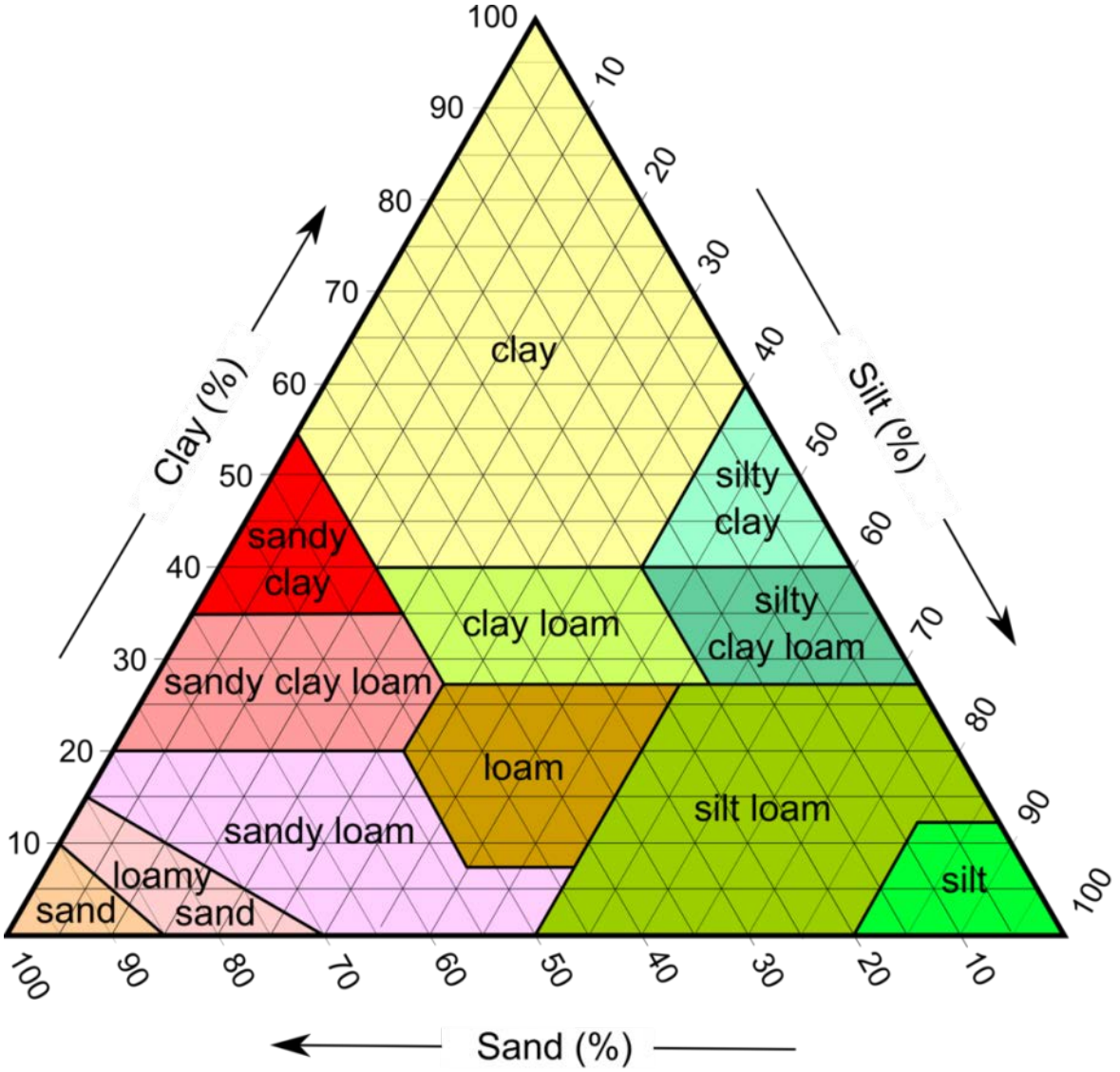
Jeremy S. Cowan
WSU Spokane County Extension
222 N. Havana St.
Spokane, WA 99202
Phone: 509-477-2145 Fax: 509-477-2087
Email: jeremy.cowan@wsu.edu


WHOA... SHE TOTALLY DOES NOT LOOK LIKE HER PROFILE PICTURE.
©2014 Scott Hilburn/Distributed by Universal Uclick
9/13

Four Principal Components of Soil



Soil Composition



Soil Management

Soil Types:

Organic

- Peat soils (>50% OM, partly decomposed)
- Muck soils (<50% OM, mostly decomposed)

Mineral

- Sand (large particles, low WHC, low nutrients)
- Silt (medium particles, high WHC, med nutrients)
- Clay (small particles, med WHC, high nutrients)

Soil Management

Soil Selection:

Organic soils

- Good for production of leaf, root, and bulb crops
- Good for germination of fine-seeded crops
- No crusting problems
- High fertility
- Slow to warm and prone to frost damage
- Poor drainage

Soil Management

Soil Selection:

Sands and Loamy Sands

- Preferred for early production
- Good for root and tuber crops
- Well drained and aerated
- Low nutrient content
- Very low WHC

Soil Management

Soil Selection:

Sandy Loams, Silt Loams, and Loams

- Preferred for most vegetable production
- Easy to work and give high yields
- Good WHC
- Moderate levels of natural nutrition
- Easy soils to maintain

Soil Management

Soil Selection:

Loamy Clays and Clays

- Suitable for late planted crops
- Productive in dryland production
- Good water retention during extended dry periods
- Poor aeration
- Can develop compaction or texture problems

Soil Management

Soil organic matter

Source of nitrogen, phosphorus, and sulfur

Increases cation exchange

Improves soil structure

Improves porosity of heavy soils

Improves heat absorption

Soil Management

Soil organic matter

Must be constantly renewed in mineral soils

Can have detrimental effects

- High salt concentration
- Layered soils
- Nitrogen tie-up

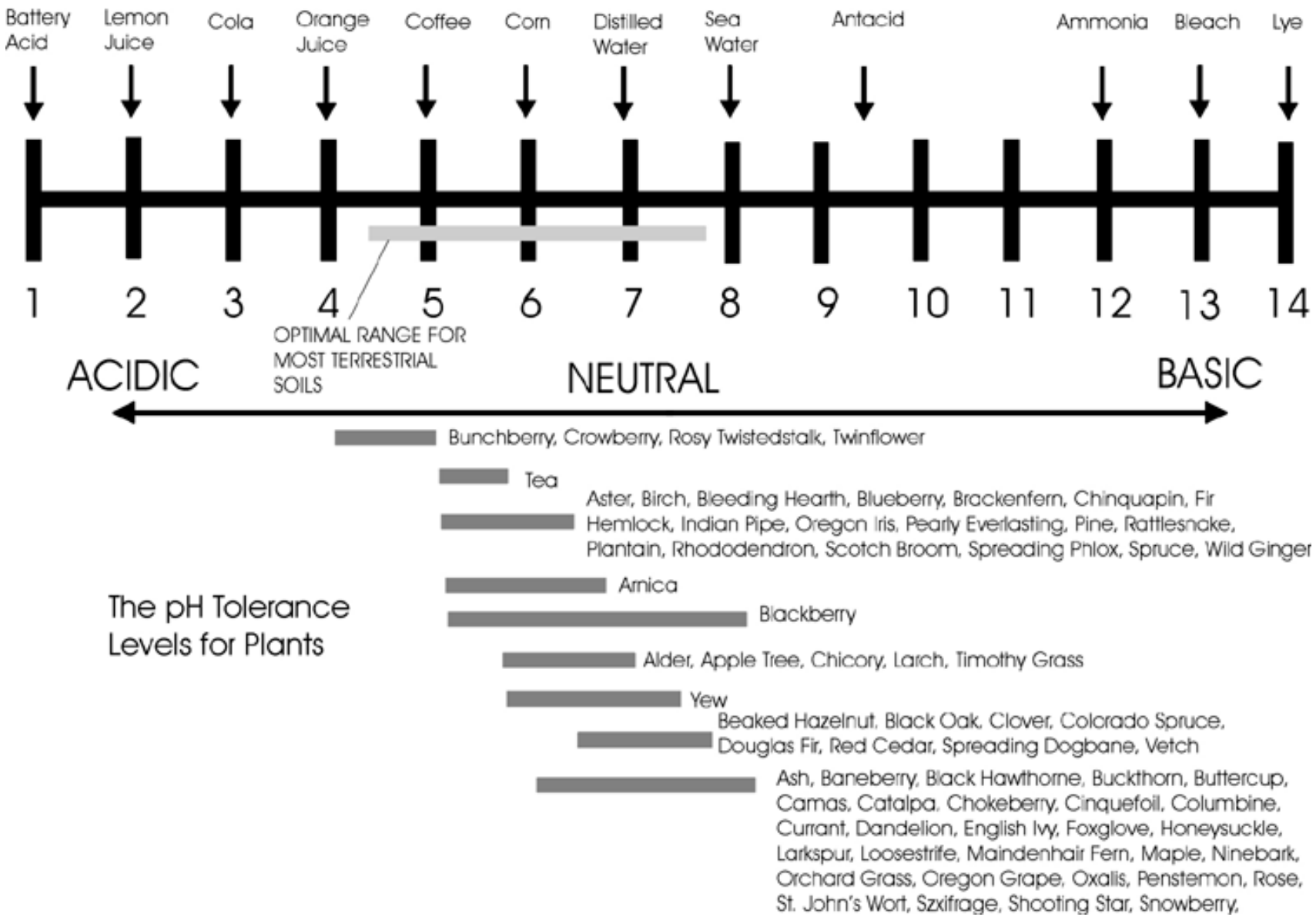
Soil Management

Soil organic matter

Sources:

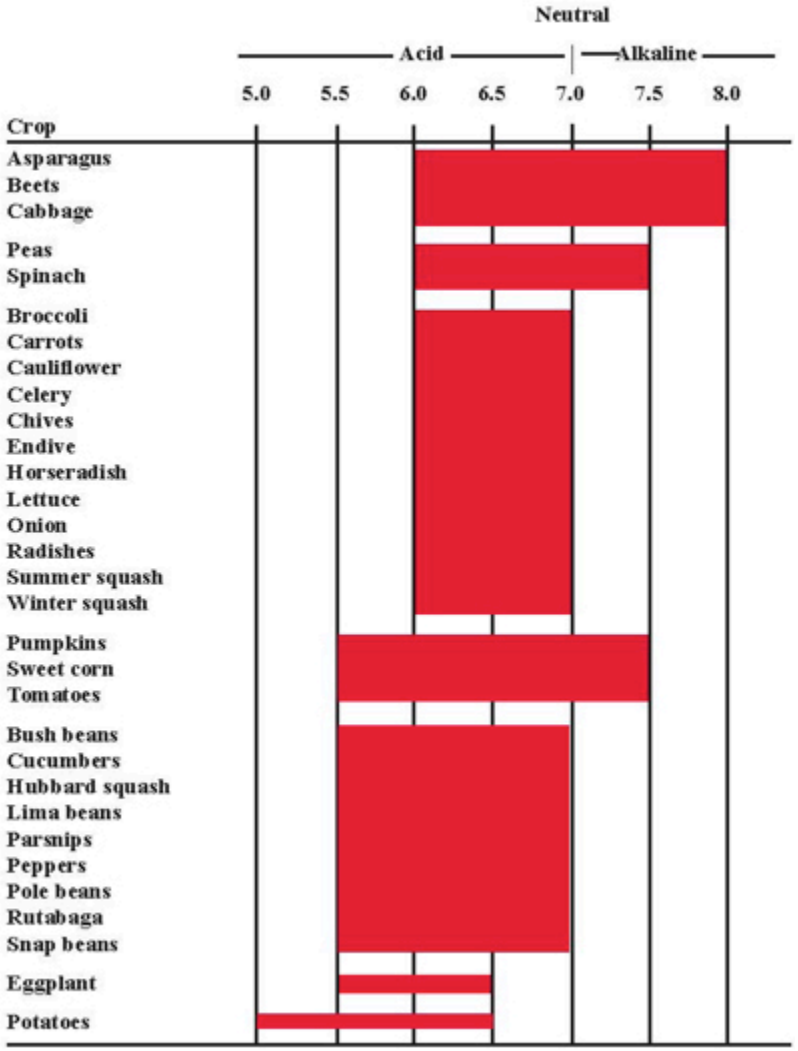
- Crop residues
- Animal manures
  - decomposed
  - fresh
- Green manures
- Cover crops

pH Scale for Soils

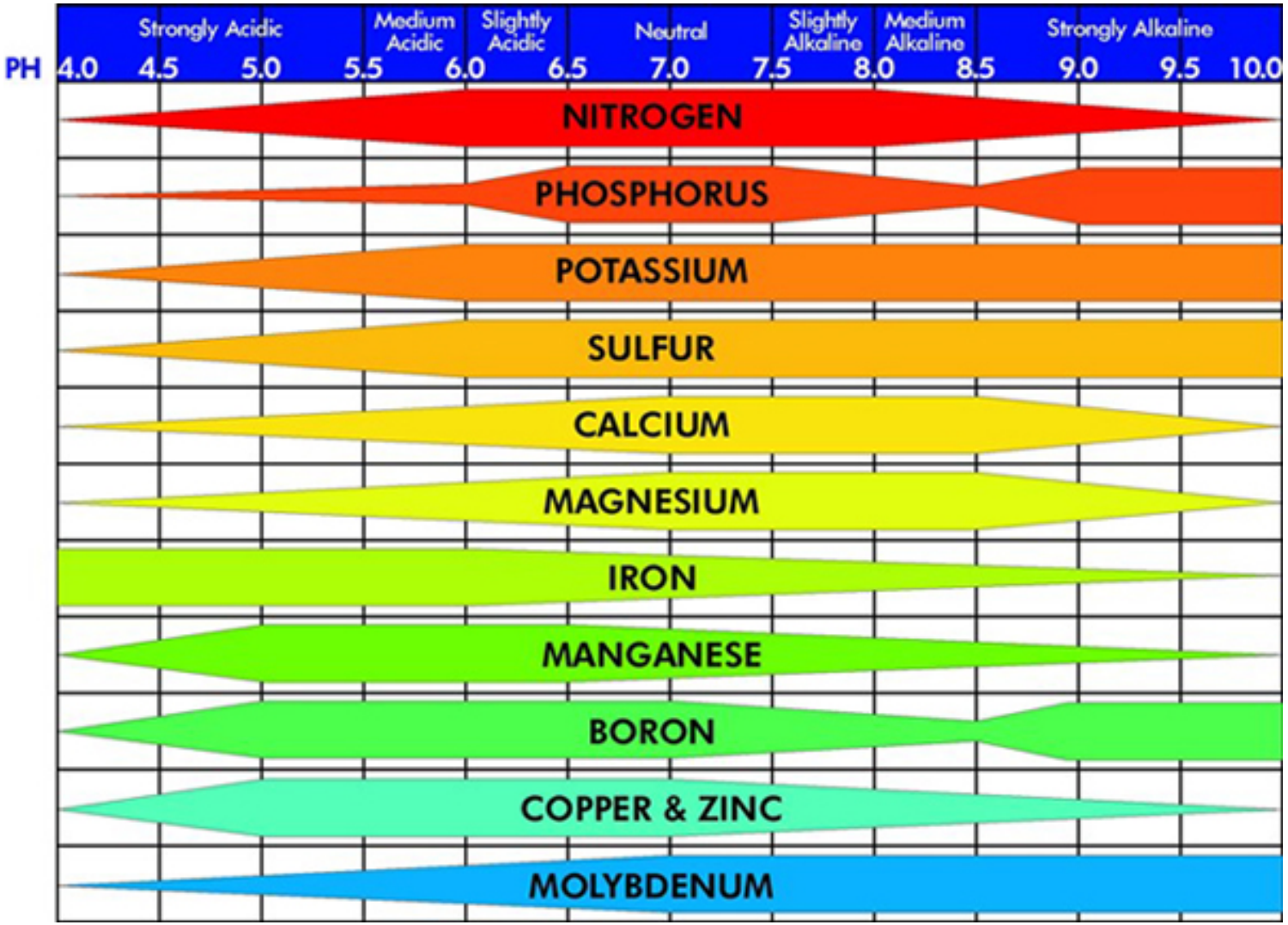


The pH Tolerance Levels for Plants

Soil Management



Soil Management



Soil Management

Soil pH

Optimum 5.0-7.0

Acid soils can be adjusted with lime

Alkaline soils are more difficult

- Sulfur compounds for short-term adjustment
- Addition of unavailable nutrients

Fertility - Mineral Nutrients

Macronutrients:

Nitrogen

Phosphorus

(**K**) Potassium

Calcium

Magnesium

Sulfur

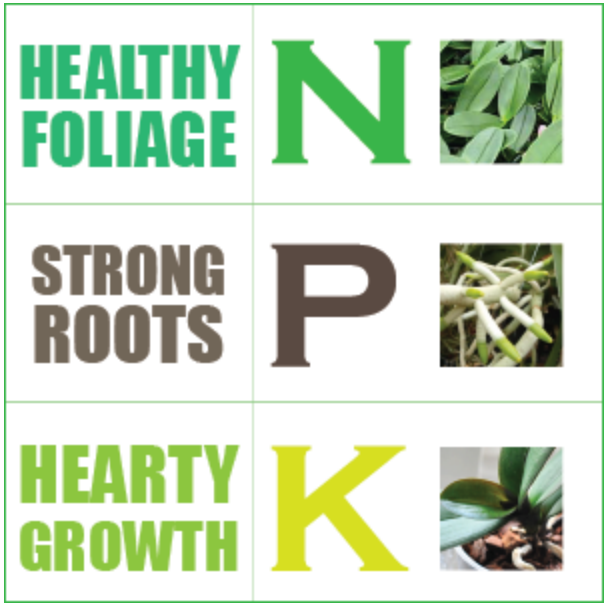


Table 6.4—Guide to the Nitrogen Fertilizer Requirements of Vegetable Crops.

Crop	Estimated Total Nitrogen Requirement	
	Dark-colored Soils Lbs. per A.	Light-colored Soils Lbs. per A.
Asparagus	80	100
Beans	30	45
Beet	50	65
Cabbage, late	60	75
Carrot	60	75
Cauliflower	65	80
Corn, late	40	55
Cucumber	20	45
Eggplant	30	45
Horseradish	45	60
Lettuce	45	60
Muskmelon	20	35
Onion	45	60
Parsnip	60	75
Peas	20	35
Pepper	30	45
Potato, late	60	75
Pumpkin and squash		
Summer squash	30	45
Winter pumpkin	60	75
Spinach	50	60
Sweet potato	30	40
Tomato	60	75
Turnip	50	50
Watermelon	20	35

Table 6.5—Phosphorus (P) and Potassium (K) Recommended for the Vegetable Crops Grouped According to Requirements.*

	Soil Test	Requirement per Group (in Pounds per Acre) I	II	III	IV
P	Very low	132	105	62	26
	Low	105	62	26	9
	Medium	70	18	18	9
	High	35	9	18	9
	Very high	18	9	18	9
K	Very low	200	200	152	56
	Low	160	160	112	16
	Medium	112	112	96	16
	High	64	64	80	16
	Very high	64	16	80	16
Crops:		Tomato Potato Pepper Eggplant Cabbage Cauliflower Broccoli Cucumber Melon Squash Pumpkin	Asparagus Onion Sweet corn Spinach Lettuce Sweet potato	Carrot Parsnip Beet Radish Turnip Horseradish	Beans Peas

*Phosphorus and potassium are given as elements instead of oxides; 20 percent phosphorus (P) equals 45.5 percent phosphorus pentoxide (P_2O_5), and 40 percent potassium (K) equals 48 percent potassium oxide (K_2O).

Fertility - Mineral Nutrients

Micronutrients:

(**Fe**) Iron

(**Mn**) Manganese

Boron

(**Cl**) Chlorine

(**Cu**) Copper

(**Zn**) Zinc

Cobalt

Molybdenum

Fertility - Mineral Nutrients

Fertilizer needs dependent on:

Crop

Soil type and pH

Residual nutrients

Organic matter

Fertility - Mineral Nutrients

Determination of fertilizer rates:

Determine intended crop

Collect soil samples

Follow published recommendations for soil type and location

Use tissue sampling and seasonal applications if appropriate

Fertility - Mineral Nutrients

kg of fertilizer needed / ft² of land to be fertilized 43,560 ft² = 1 acre

Amount of Urea = $\frac{90 \times 400}{46 \times 10{,}000} \times 100$ = **7.8 kg** (Assuming 46% N in Urea)

Amount TSP = $\frac{60 \times 400}{20 \times 10{,}000} \times 100$ = **12 kg** (Assuming 20% P in Triple Super Phosphate)

Amount of MP = $\frac{30 \times 400}{50 \times 10{,}000} \times 100$ = **2.4 kg** (Assuming 50% K in Muriate of potash)

Amount of Zinc sulfate = $\frac{15 \times 400}{36 \times 10{,}000} \times 100$ = **1.7 kg** (Assuming 36% Zn in ZnSO4)

Amount of Gypsum = $\frac{10 \times 400}{18 \times 10000} \times 100$ = **0.6 kg** (Assuming 18% S in Gypsum)

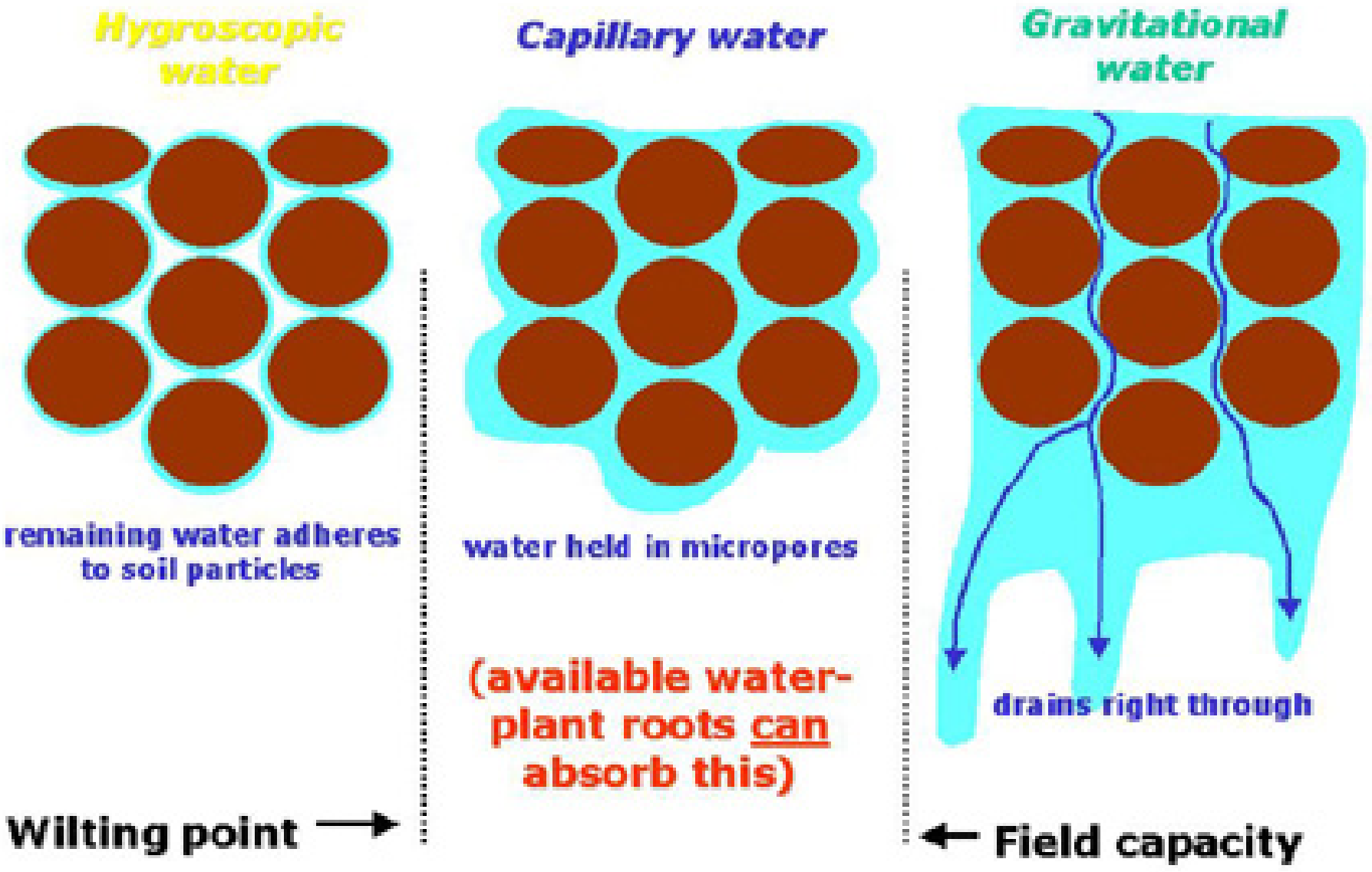
Irrigation

Amount and frequency dependent on:

- Crop requirement
- Environmental conditions
- Soil type

Irrigation equipment type dependent on:

- Intended crop use and crop response
- Water availability and price
- Soil characteristics


Hygroscopic water
Capillary water
Gravitational water
remaining water adheres to soil particles
water held in micropores
drains right through
(available water- plant roots can absorb this)
Wilting point
Field capacity

Irrigation

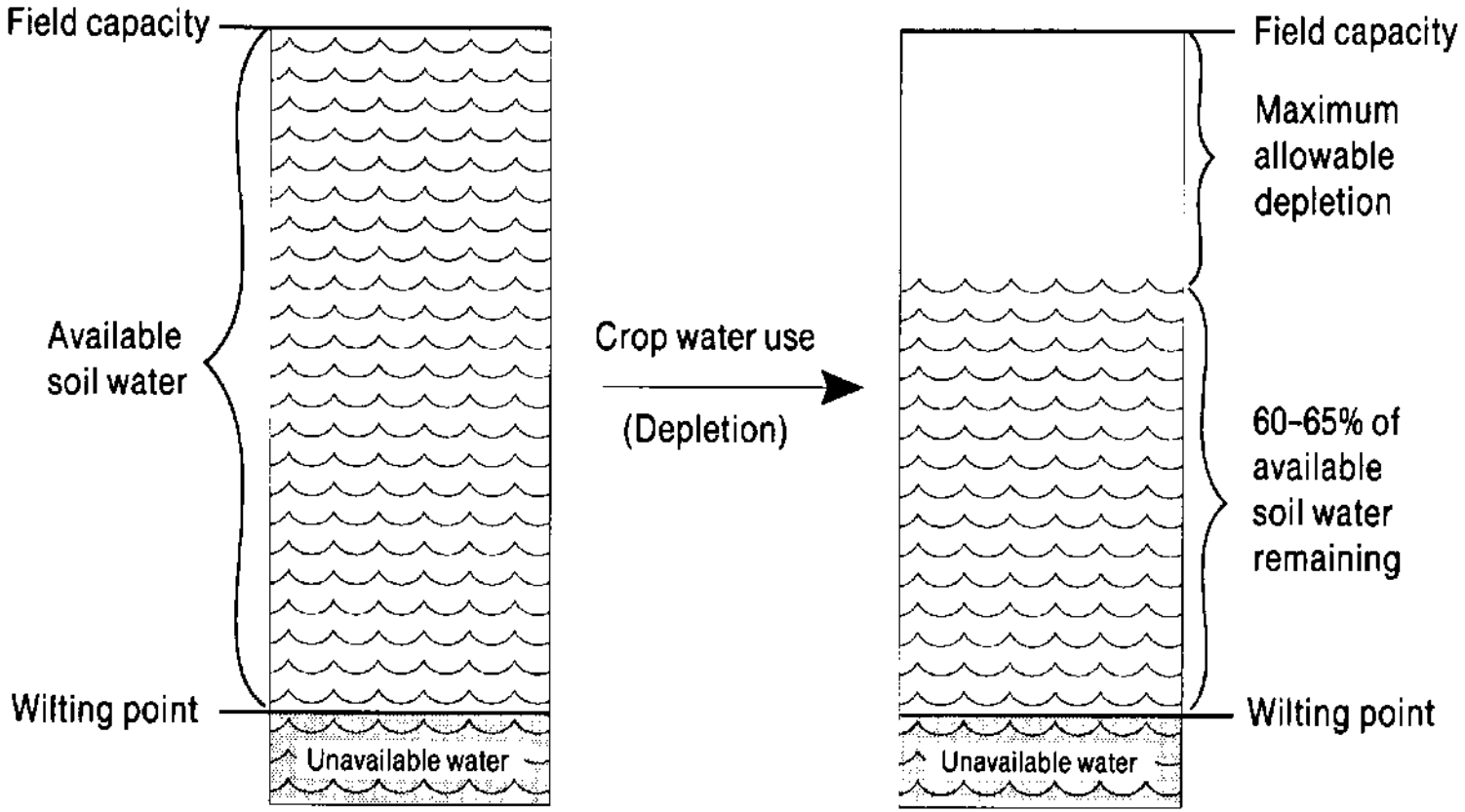


Fig. 8.2. Available soil water is the difference between the field capacity of a soil (the amount of water retained in the total soil pore space after saturated soil has drained) and the permanent wilting point (the point at which plants can no longer obtain water from the soil and thus wilt and die). Allowable depletion is the point to which available soil water can be depleted without inducing plant stress. For potatoes, the soil must always be maintained above 60–65% of available soil water.

Irrigation

Table 8.2. Available soil water and infiltration rates in soils of various textures

Soil texture[a]	Available soil water (in./ft)	Infiltration rate (in./hr)
Coarse sand	0.4–0.7	0.5–1.0
Fine sand	0.7–0.9	0.5–1.0
Loamy sand	0.9–1.3	0.5–1.0
Sandy loam	1.2–1.9	0.5–1.0
Loam	1.8–2.6	0.3–0.5
Silt loam	2.0–3.0	0.3–0.5
Clay loam	2.0–2.6	0.1–0.3
Clay	1.8–2.4	0.1–0.3

[a] Soil textures are defined in Figure 2.3.

Irrigation

Types of irrigation equipment:

Surface or flood

Sprinkler

- hand move
- side roll
- big gun
- center pivot

Trickle or drip systems

Sub-irrigation

Irrigation

Types of irrigation equipment:

Surface or flood

Sprinkler

- hand move
- side roll
- big gun
- center pivot

Trickle or drip systems

Sub-irrigation

Irrigation

Types of irrigation equipment:

Surface or flood

Sprinkler

- hand move
- **side roll**
- big gun
- center pivot

Trickle or drip systems

Sub-irrigation

Irrigation

Types of irrigation equipment:

Surface or flood

Sprinkler

- hand move
- side roll
- big gun
- **center pivot**

Trickle or drip systems

Sub-irrigation


YOU'RE CUTTING OFF HIS NOSE FOR FIREWOOD? BUT HOW WILL HE SMELL?
LIKE PINE. SAME AS ALWAYS. NOW LIE TO ME, PINOCCHIO! LIE FOR WARMTH!
SCOTT HILBURN
7/22
©2014 Scott Hilburn/Distributed by Universal Uclick

Weed Control

Common weeds in vegetables:

Grasses

foxtail, wild oats, barnyard grass

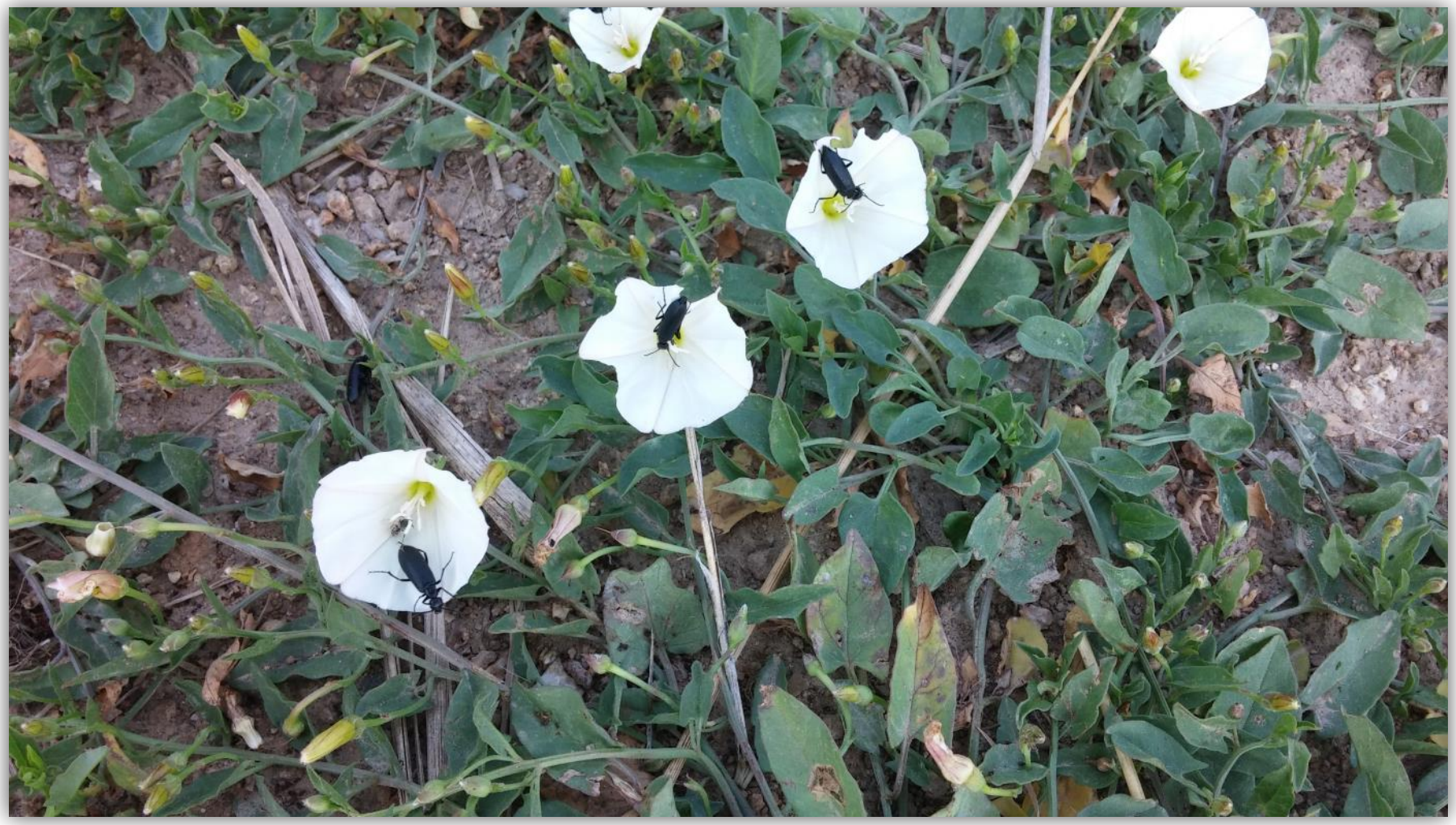
Broadleaf

redroot pigweed, lambsquarter, purslane, kochia, Canada thistle, bindweed

Sedges

yellow nutsedge

Weed Control



Weed Control

Weed Control

Weed Control

Methods of weed control:

Cultivation

Mulching
- organic materials
- manmade materials

Herbicides

Weed Control

Potential problems with herbicide use:

Limited choice of registered compounds

Lack of efficacy

Presence of resistant weed species

Crop sensitivity

Weed Control

Reasons for herbicide effectiveness:

Crop morphology (i.e. waxy leaves)

Application timing (i.e. root inhibitors)

Spray placement (i.e. spray shields)

Biochemical crop tolerance (selectivity)

Weed Control

Factors affecting rates and timing:

Soil type

Environmental conditions

Stage of crop growth


WHO WANTS TO CORRECTLY DIAGRAM THIS SENTENCE?
SCARED, YODA WAS
©2014 Scott Hilburn/Distributed by Universal Uclick
7/23
SCOTT HILBURN

Disease Control

What is Plant Disease?

ANY malfunctioning of host cells and tissues that results from continuous irritation by a pathogenic agent or environmental factor and leads to the development of symptoms

Disease Control

Agents of Plant Disease:

Nonparasitic – noninfectious, abiotic

Parasitic – Infectious, biotic

An organism living on or in another living organism (host) and obtaining its food from the latter.

Disease Control

Plant Pathogens:

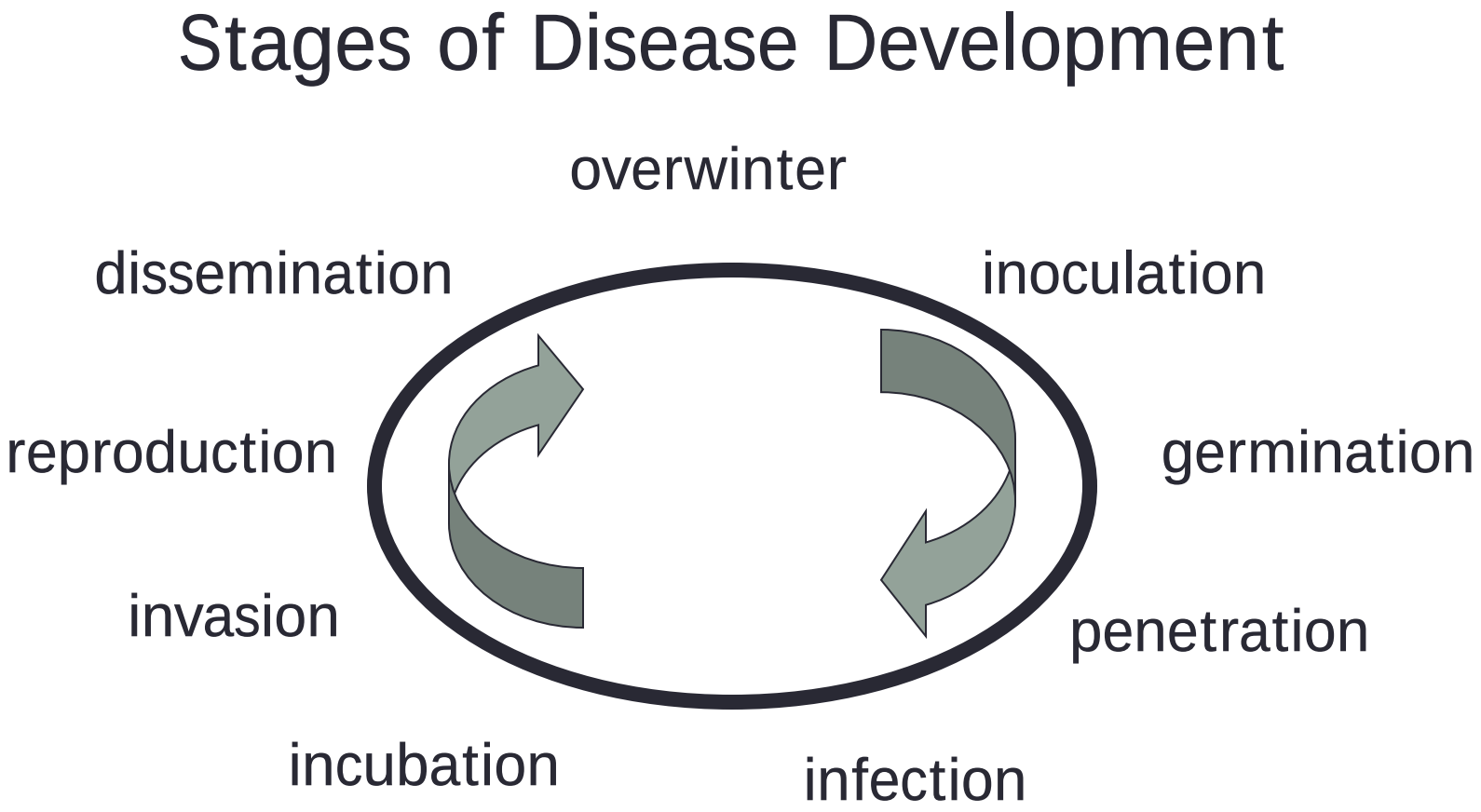
Compete with crop plants by using metabolites, carbohydrates and other nutrients produced by the host

Reduce photosynthetic efficiency

Reduce water and nutrient uptake

Disrupt normal growth and metabolites at the cellular level

Disease Cycle – Pathogen Life Cycle



Disease Control

Disease-causing pathogens:

Viruses

Fungi

Bacteria

Mycoplasmae

Disease-Causing Pathogens

Fungi

> 100,000 known species, most are saprophytic

only **10,000** species are known to cause disease in plants

Beneficials

- decay plant and animal tissues
- symbionts – mycorrhizae
- antibiotics – *Penicillium*, *Gleocladium* species

Fungi

Fungi

Fungi

Symptoms of Fungal Infection

Root rots

Basal stem rot / wirestem

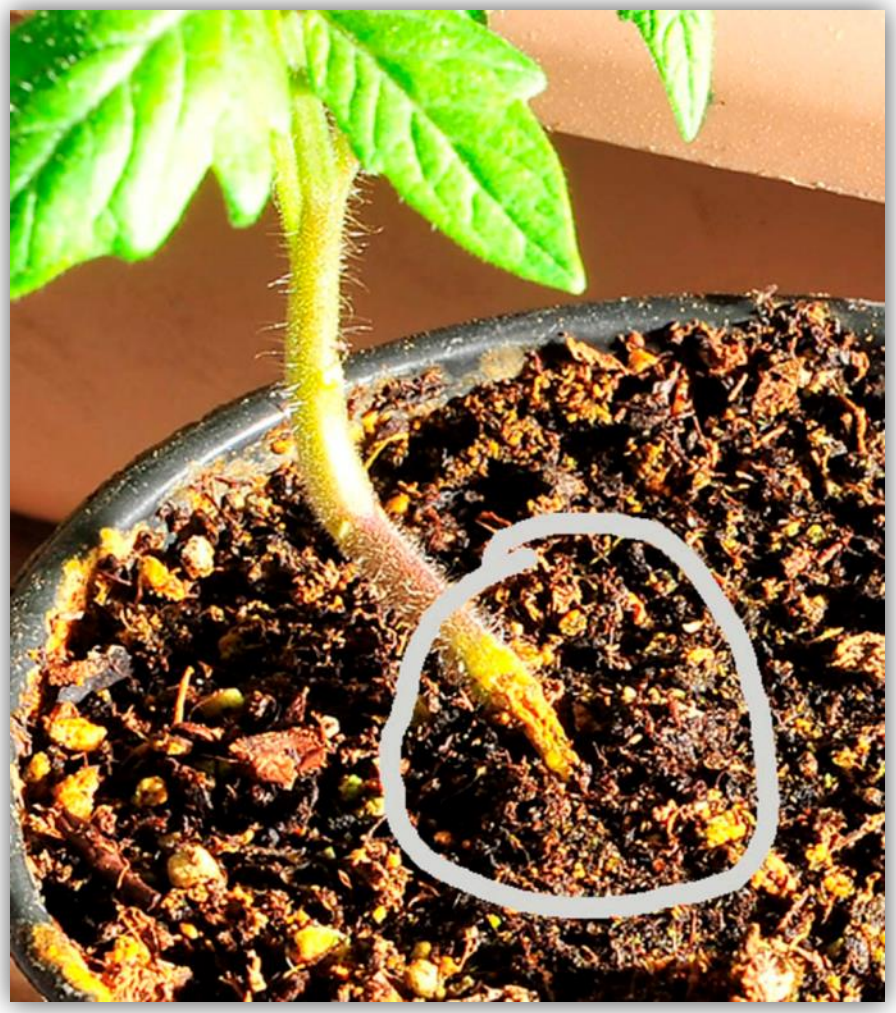
Damping-off

Canker

Scab

Leaf spots

Blights



Symptoms of Fungal Infection

Soft rots and dry rots

Clubroots

Galls

Witches' broom

Warts

Leaf curl

Control of Fungal Diseases

Soil fumigation – methyl bromide, vapam

Use disease free propagules

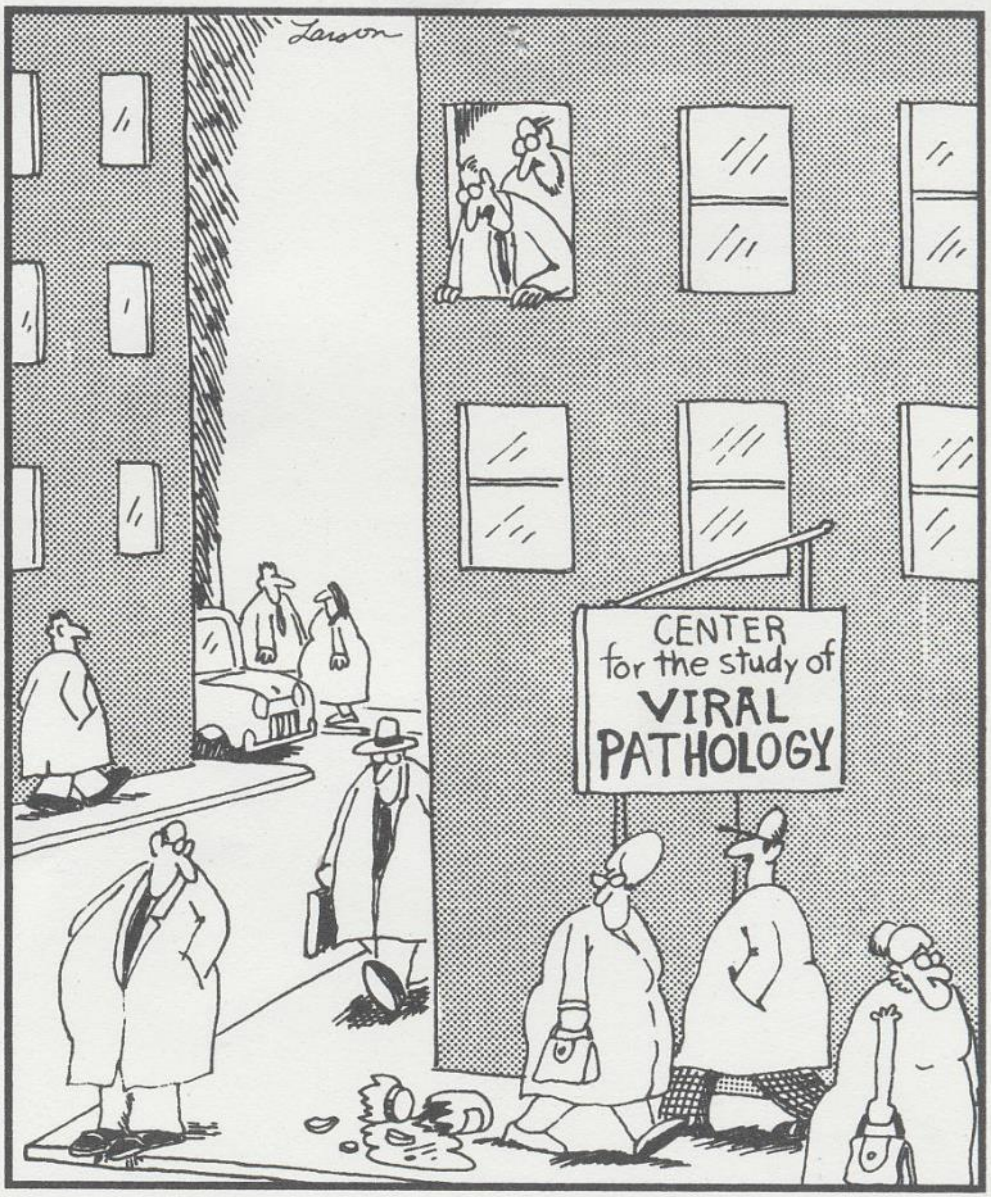
Resistant varieties

Fungicides

Crop rotation

Cultural practices – sanitation / no wounds

Biocontrol agents / antagonists



"Uh-oh."

Virus Diseases

Virus particles

A = flexous threadlike virus

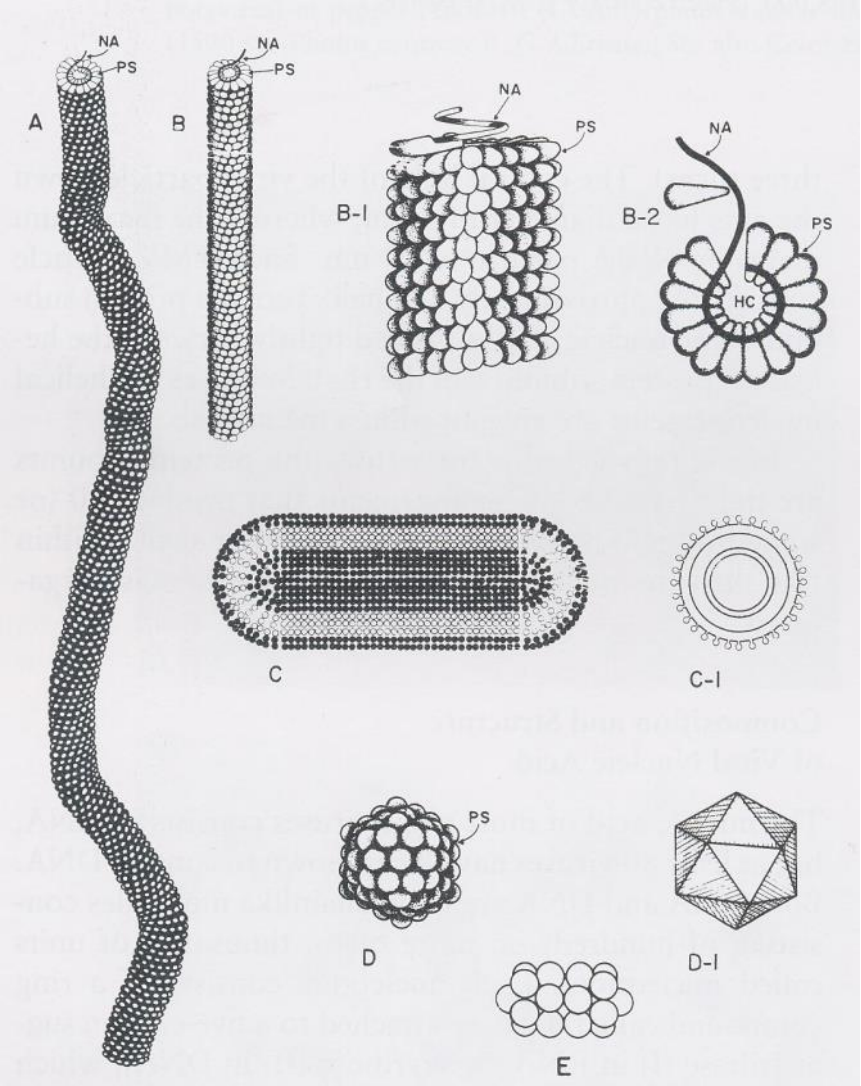
B = rigid rod-shaped virus

C = short, bacillus like-virus

D = polyhedral virus

D1 = icosahedron

E = geminivirus



Virus Diseases

Obligate parasites

To cause disease, they must have a vector:

- Insects (aphids, leafhoppers, thrips)
- Soil-borne fungi
- Nematodes
- Infected seed
- Mechanical transmission (humans)

Virus Diseases

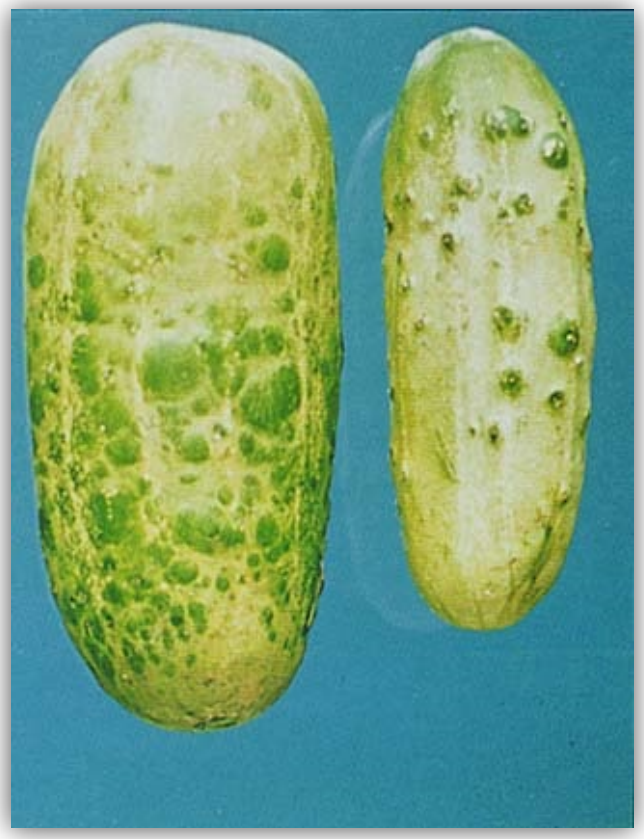
Given name based on host and symptoms:

Tomato Ringspot Virus

Cucumber Mosaic Virus

Tobacco Mosiac Virus

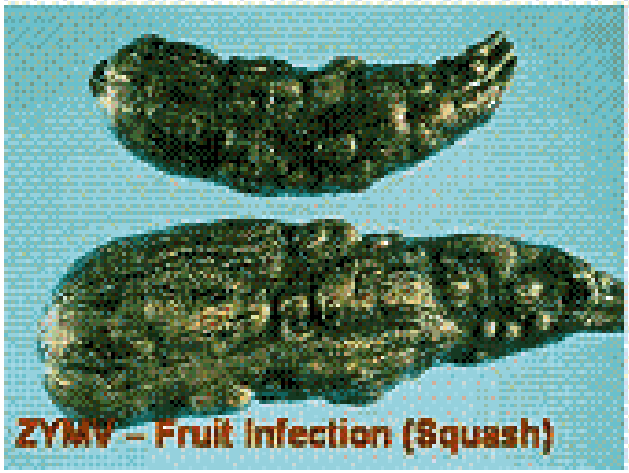
Potato Leaf Roll Virus



Virus Diseases

Virus Diseases

Virus Diseases



Virus Diseases

Control of virus diseases:

Control insect vectors

Resistant varieties

Use virus-free material (certified seed)

Diseases caused by bacteria

Diseases caused by bacteria

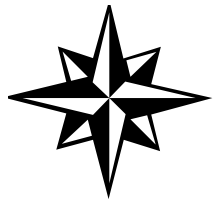
Control of Bacterial Disease

- Mostly copper based (Bordeaux mix, Kocide, copper sulfate)
- Antibiotics – streptomycin
- Resistant varieties
- Insect control
- Sanitation

General Disease Control Strategies

Disease control strategies:

Utilize certified seed
Control refuge species
Select disease-free production sites
Use disease resistant cultivars
Utilize crop rotation
Optimize planting date for avoidance
Apply appropriate pesticides when necessary
Control vectors




STACY, SWEETIE, YOU LEFT YOUR SALAD HERE IN THE BEDROOM. BY THE WAY, HAVE YOU SEEN MY DIRTY LAUNDRY BASKET?
GULP
©2014 Scott Hilburn/Distributed by Universal Uclick
7/21
GREEN GIANT PROBLEMS

Insect Control

Monitoring populations

Scouting
- plant inspections for insects
- plant inspections for injury
- sweep nets

Trapping
- Baits
- Hormone traps

Insect Control

Action decisions:

Determine injury potential (life cycle)

Determine economic threshold

Determine potential for future population shifts (sources and reproductive rate)

Insect Control

Insect control strategies:

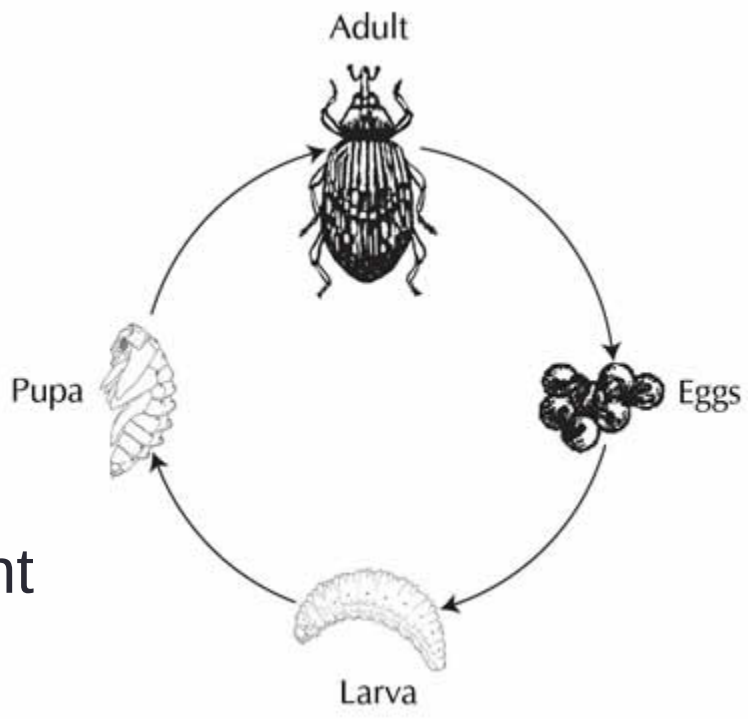
Eliminate refuges

Protect beneficial insects

Understand the life cycle of important pests

Design an effective scouting program

Timely insecticide applications



Insect Control

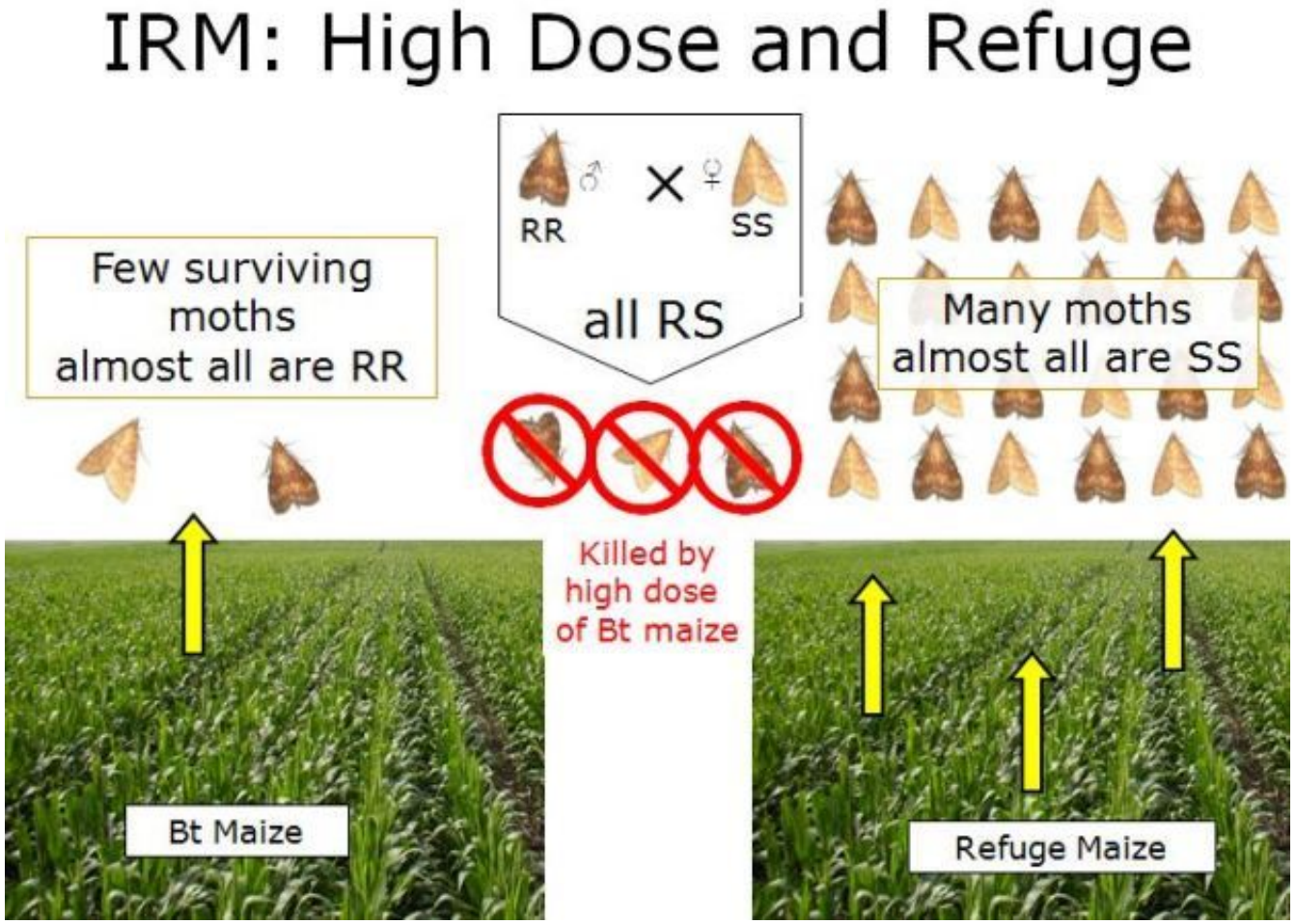
Resistance management:

Avoid insecticide applications when possible

Rotate insecticides with different modes of action

Maintain refuges when appropriate

Insect Control




YO, SARGE, WE GOT ANOTHER BODY OVER HERE.
SCOTT HILBURN
©2014 Scott Hilburn/Distributed by Universal Uclick 5/17